



## Silentium<sup>3+</sup>

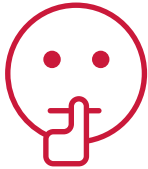
Our 3-step approach to your industrial equipment challenges

# Discover our smart approach to silencing, sealing and filtering

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The world of industrial equipment is evolving towards quieter machines which help to improve living standards in their surrounding environments. This includes equipment used in compressed air, off-grid power generation, heat pumps and HVAC (in residential, light commercial and industrial applications).

Carpenter has extensive expertise and years of experience in industrial equipment. We use this to design and manufacture custom-made converted parts that provide highly effective silencing, sealing and filtering solutions.



SILENCING



SEALING



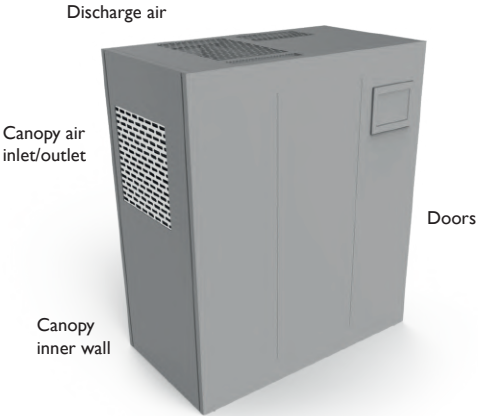
FILTERING

Silencing is particularly important in protecting people and the environment around industrial equipment. It also ensures that machinery meets, or ideally exceeds, applicable regulations. Carpenter provides versatile acoustic absorption, transmission loss and damping solutions based on the Silentium<sup>3+</sup> approach.

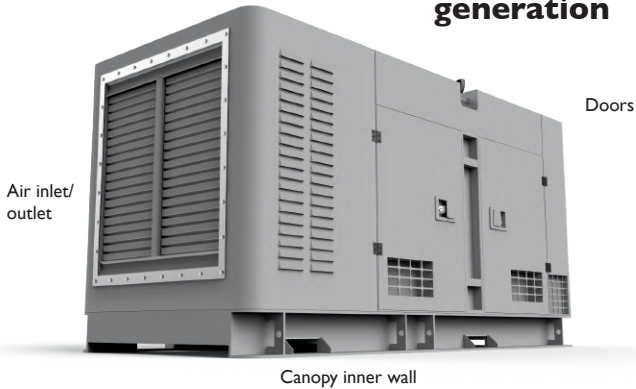
## Silentium<sup>3+</sup>

Our 3-step approach

# Compressed air

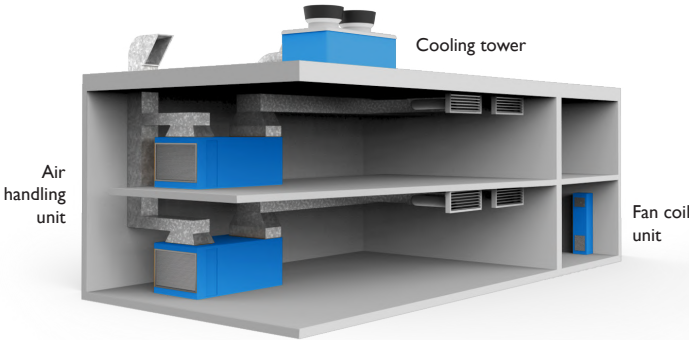


# Off-grid power generation

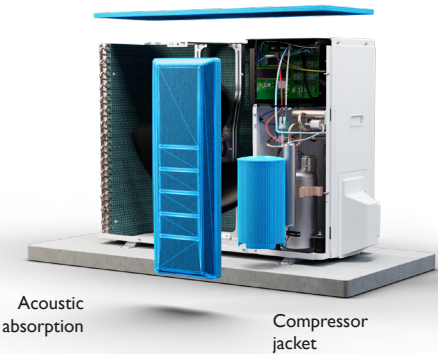


# HVAC

(in residential, light commercial and industrial applications)

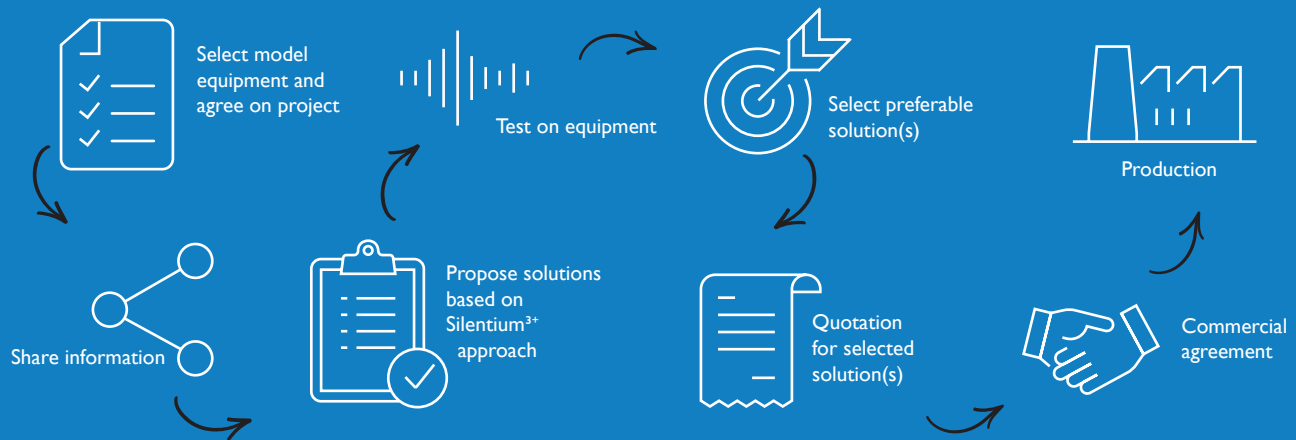


# Heat pump



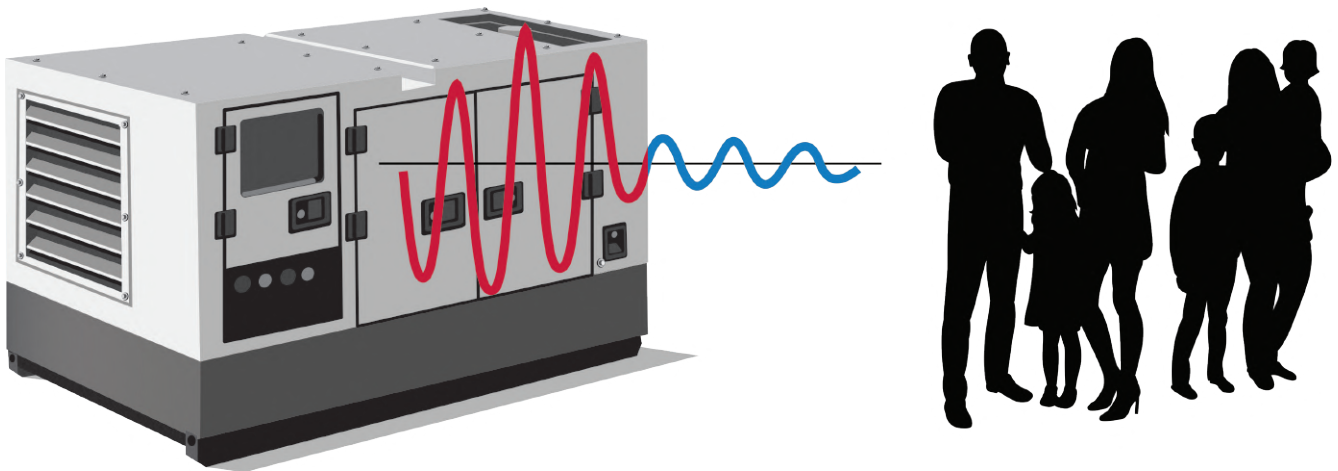
# A customer-focused process...

Cooperation and team effort are key words in our approach, which is tailored to meet each customer's needs. In the first phase, the customer selects the equipment model that needs to be designed (or redesigned). In the second phase, we share more detailed information about the project, such as model drawings, the specific noise signature of the equipment, etc. Based on this information, we design several solutions which we then test in a third phase at the customer's facility or in our labs. This allows us to select the most suitable solution for production.



# ... that helps to protect (your) people

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These solutions also benefit people who live and work close to industrial equipment. Reducing noise emissions from machinery helps to protect workers, creating a safer, healthier and more productive workplace. For those in manufacturing environments, our solutions avoid the health risks associated with mineral wool during handling and installation. For residents living in the vicinity of HVAC systems, heat pumps and generators, effective noise reduction leads to better wellbeing, improved sleep and a higher quality of life.

# Silentium<sup>3+</sup>

## Our 3-step approach

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## Analysis

As a service we can analyse the noise spectrum of the equipment, we identify the location of the noise source, its critical frequencies and sound levels. Your equipment can be analysed at your facilities or in our lab.

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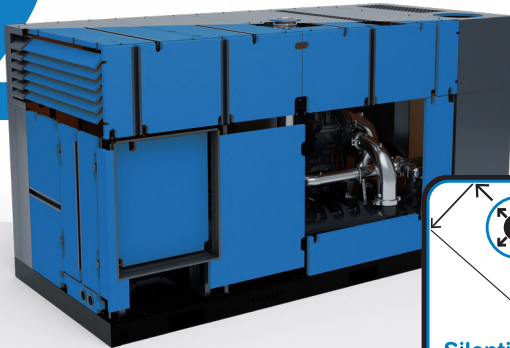
## Source

Reduce noise/vibrations at the **source**

- Reducing noise at the source is the most effective treatment. A more silent engine, compressor or fan requires less noise treatment.
- Vibration damping materials such as a constraint layer or damping layer are used to reduce the vibration and resonance amplitude.
- Using encapsulation on the source reduces the noise level significantly.



# 2

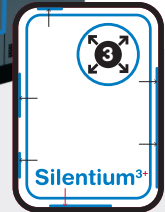


## Inside

Reduce noise on the **inside**

- Absorbing sound on the inside of the canopy is the most common acoustic treatment. This step is less complex than the other two steps because it has a lower impact on the design of the equipment.
- Different absorption and/or reflection solutions are possible to redirect the noise.
- We choose the most effective solution for the specific noise signature of the industrial equipment in combination with specific customer needs (fire resistance, moisture repellence, working temperature, etc.).

# 3



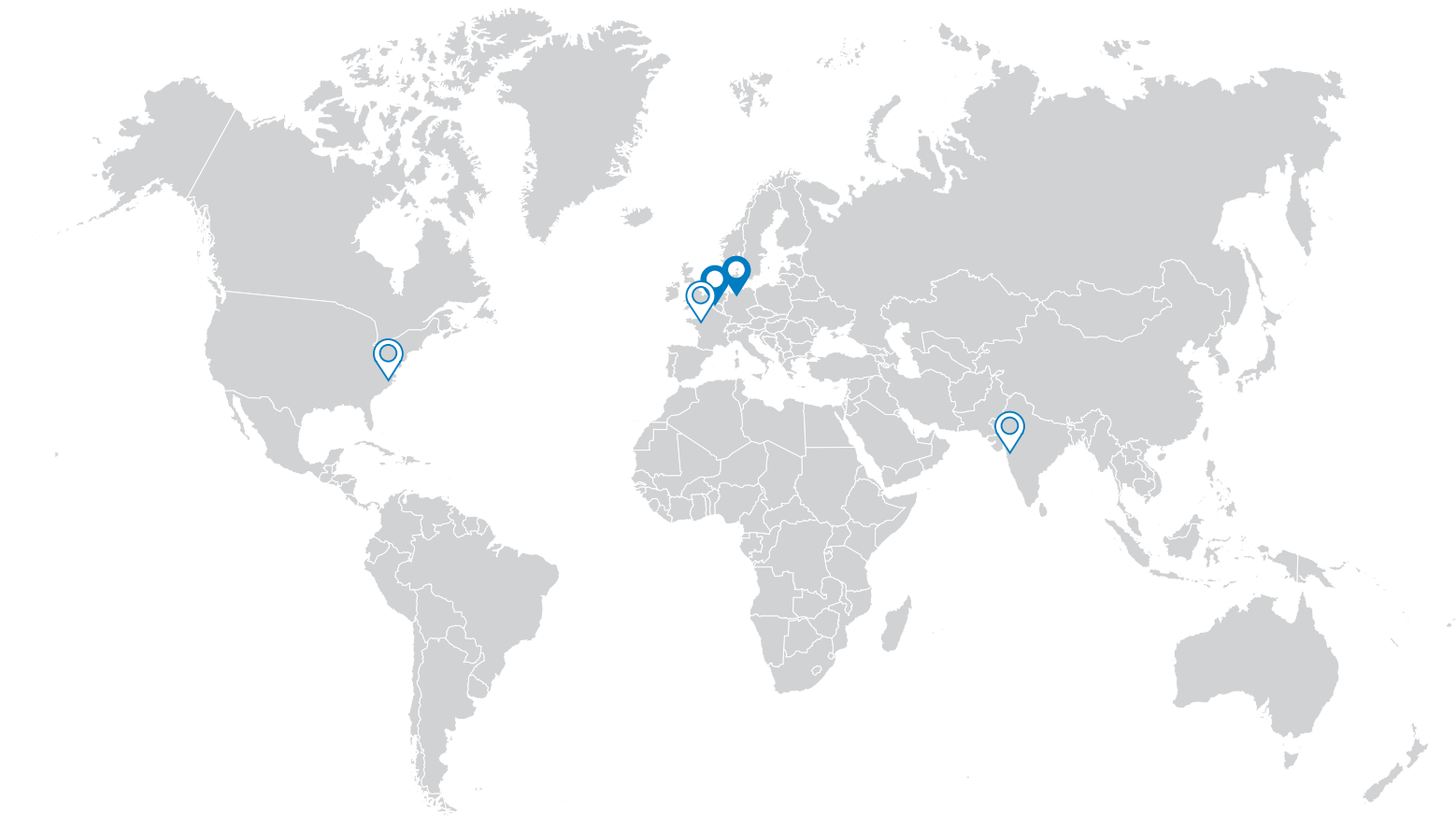
## Outside

Prevent noise **exiting** the equipment

- Prevent sound leakage by using sealants (to eliminate openings), louvers (to eliminate direct sound paths), mass for sound insulation and/or vibration damping material.
- The last step is to keep the sound inside the equipment, as noise will always partially penetrate the absorption material.
- Transmission loss can be improved by adding mass (as a barrier), a mass spring system or specific damping materials.

# Acoustic capabilities

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## Lab locations



### **Acoustic centre of excellence**

Lab scale: small to large-scale testing

On-site: portable equipment to test at customer's site



### **Acoustic centre**

Lab scale: small-scale testing

On-site: portable equipment to test at customer's site

# Lab scale measurements

	SMALL LAB SCALE		MEDIUM LAB SCALE		LARGE LAB SCALE		
	IMPEDANCE TUBE		ALPHA CABIN		REVERBERATION ROOM	COUPLED ROOM	HEMI-ANECHOIC CHAMBER
	ABSORPTION	TRANSMISSION LOSS	ABSORPTION	TRANSMISSION LOSS	ABSORPTION	TRANSMISSION LOSS	SOUND POWER LEVEL/INTENSITY
EU BELGIUM	X	X	X	X	X	X	X
EU GERMANY	X	X	X			X	X
US	X						
IN	X	X					

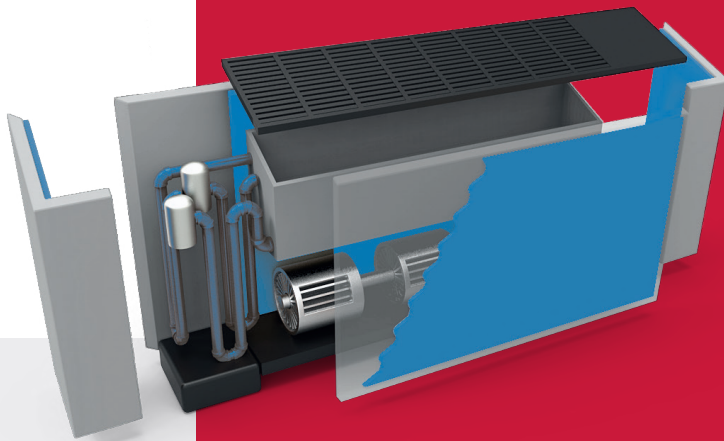
# On-site measurements

	SONOMETER	INTENSITY PROBE
	SOUND POWER LEVEL	SOUND INTENSITY
EU BELGIUM	X	X
EU FRANCE	X	
EU GERMANY	X	X
IN	X	

# Our product families



## SILENCING Portfolio



Enclosure with acoustic absorbing foam

Silencing is essential in industrial equipment. It protects the environment and people around machinery and ensures that it meets, or ideally exceeds, applicable regulations. Carpenter provides versatile acoustic absorption, transmission loss and damping solutions based on the Silentium<sup>3+</sup> approach.

Acoustic absorption absorbs reverberated noise within the canopy. Transmission loss decreases the transmission of noise to the outside. Damping reduces the vibration of metal sheets so that they create less noise.

PU foams are often used for sound absorption, but they can also be used as base for creating sound reflecting or transmission loss complexes.


# Sound absorption

## Silentium bases


**Dockets**  
FMVSS 302 passing foams



**Fireflex®**  
UL94 – HFI passing foams



**Firend® / Fireseal™**  
Various fire requirement fulfilling impregnated foams



**Melamine foam**  
EN 13501 – Class B/C fulfilling foams




## Silentium A complexes


**Silentium A xxAx**  
Cleanable facing







**Silentium A xxBx**  
Robust facing





**Silentium A xxFx**  
Heat reflective facing






# Transmission loss

## Silentium T complexes

**Silentium T M**  
Heavy mass system




**Silentium T M+**  
Absorption + Heavy mass system



**Silentium T MS**  
Mass spring system




**Silentium T MS+**  
Absorption + Mass spring system




# Damping vibrations

## Silentium D solutions

**Silentium D M**  
Extensional damper



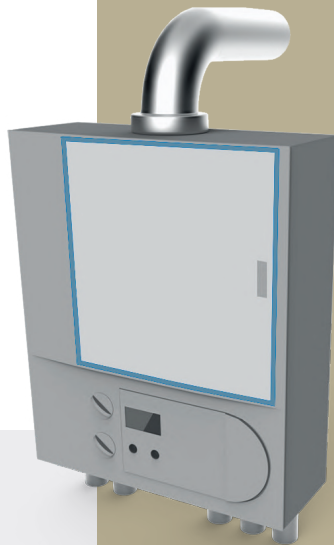
**Silentium D CL**  
Constrained layer



# Our product families



## SEALING Portfolio



HVAC unit with  
sealed doors

Sealing is used to prevent noise leakage, as small openings create direct paths to the receiver outside the canopy. The most appropriate sealing solution is selected depending on the acoustic target and the secondary properties. Secondary properties are fire resistance, heat resistance, UV resistance, environmental conditions, thermal insulation, etc.

**dBRSeal P**  
PU air sealing

**dBRSeal V**  
PVC air sealing

**dBRSeal R**  
EPDM air sealing

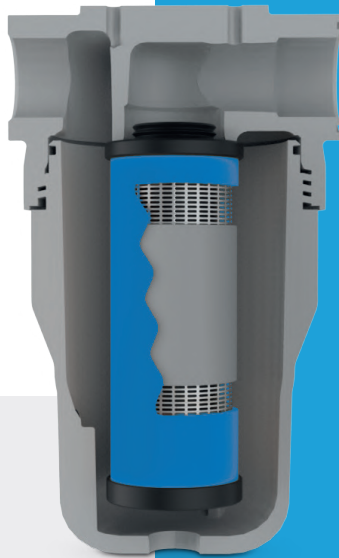
**Hydroseal® P**  
PU water sealing

**Hydroseal® E**  
PE water sealing

**Hydroseal® R**  
EPDM water sealing



## FILTERING Portfolio



Filters are primarily used to filter particles (solid or liquid) out of air and fluids, but selecting the right solution can also reduce the noise inside the filter system. The most appropriate filter solution is selected depending on the acoustic target and the secondary properties such as fire resistance, heat resistance, UV resistance, environmental conditions, etc.

**Bulpren® / Regicell**

Filter foam for dry environments

**Filtren® / PolinaCell**

Filter foam for aquatic/humid environments

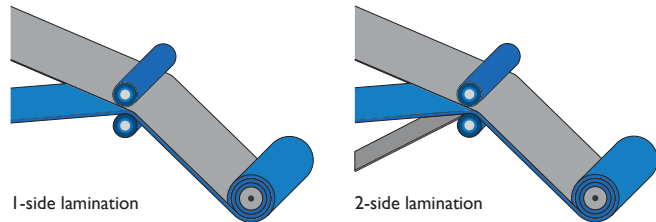
Filter (removes oil, dust, etc.  
from the discharged air)

# Technologies

Carpenter provides a wide range of technologies, from basic 2D cutting to highly sophisticated 3D moulding. This technology portfolio is unique to Carpenter. It enables us to tailor our products and offer our customers alternative solutions with the right price/performance ratio for their needs.

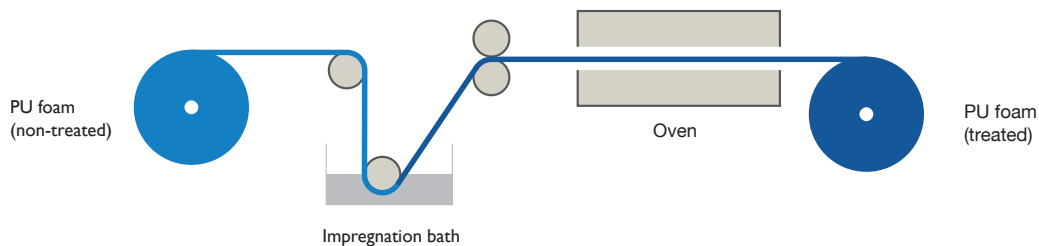
## Lamination

Lamination is key to create added value complexes. Top layers are applied to boost absorption, improve cleanability after rental, add robustness and longevity, reflect heat, improve transmission loss, etc.



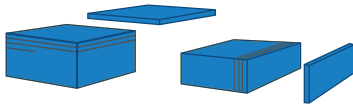
## Impregnation

Impregnation is used to improve the fire-resistant properties of the initial foam.

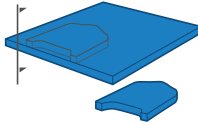


## 2D & 3D Cutting

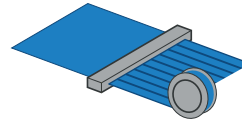
Cutting is essential to create the parts, kits and/or plates to be delivered to the customer.



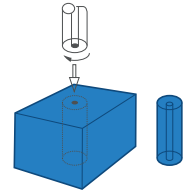
Horizontal & vertical splitting (2D)



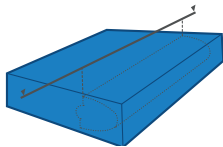
Model cutting (2D)



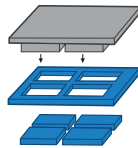
Spooling (2D)



Drilling (2D)



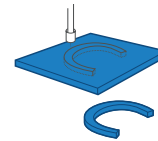
Contour/CNC cutting (3D)



Die cutting (2D)



Milling (3D)



Water jet cutting (2D)



Deformation cutting (2D)

## Reticulation

Reticulation is the process to fully open the cell structure of the foam.



# About Carpenter

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Founded in 1950, Carpenter Co. is the world's largest vertically integrated manufacturer of polyurethane foams. Carpenter also serves a diversified global marketplace with polyurethane chemical solutions, polyester fibers, and insulation materials through a network of more than 70 production locations. Our 6,500+ employees across the globe seek to provide the most innovative products and solutions with a focus on enhancing the quality of people's lives while being a good steward of our resources

## Tailored solutions and innovations

The key to the success of PU foams is their seemingly endless versatility. Many everyday objects would be unimaginable without their unique benefits, which include silencing, sealing, filtering, carrying, protecting, supporting and comforting attributes. These can be provided in almost any combination, allowing us to develop solutions and systems with the exact functionalities required by every market we serve.

Find out more at:

**[www.carpenter.com](http://www.carpenter.com)**



Carpenter Engineered Foams  
Culliganlaan 2F  
1831 Machelen  
Belgium  
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